
China Drills Into Shale Gas, Targeting Huge Reserves Amid Challenges

by CATHERINE T. YANG • AUG. 8, 2012

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Hills and water have shaped the story of Chongqing, in China's southwest. At the confluence of the Yangtze and Jialing rivers, the Sichuan Province city became China's first inland port open to foreign commerce in 1891. In the 1930s and '40s, Chongqing served as China's wartime capital, although the mountain ranges on all four sides provided less of a buffer than hoped against Japanese air raids.

Now a new chapter in Chongqing's history is being written, as hydraulic fracturing rigs assembled this summer in this undulating landscape to drill into one of China's first shale gas exploration sites.

(Related Pictures: "[A Rare Look Inside China's Energy Machine](#)")

Technology to force natural gas from its underground source rock, shale, has transformed the energy picture of the United States in the past six years, and China—sitting on reserves some 50 percent larger than those of the U.S.—has taken note. Hydraulic fracturing, or fracking, is a made-in-the-U.S.A. process that China aims to import.

(Related Interactive: "[Breaking Fuel From the Rock](#)")

On June 9, state-owned oil giant [Sinopec](#) started drilling the first of nine planned shale gas wells in Chongqing, expecting by year's end to produce 11 billion to 18 billion cubic feet (300 to 500 million cubic meters) of natural gas—about the amount China consumes in a single day. It's a small start, but China's ambitions are large; by 2020, the nation's goal is for shale gas to provide 6 percent of its massive energy needs.

(Related Quiz: "[What You Don't Know About Natural Gas](#)")

Because natural gas generates electricity with half the carbon dioxide emissions of coal, China's primary power source, the hope is that shale development, if it is done in an environmentally sound manner, will help pave the way to a cleaner energy future for the world's number one greenhouse gas producer. "Clean, rapid shale gas development in China would reduce global emissions," says Julio Friedmann, chief energy technologist at the U.S. Department of Energy's [Lawrence Livermore National Laboratory](#) in California, which has been working with the Chinese on environmentally sound fracking practices.

But challenges lie ahead in China's effort to replicate the U.S. shale gas revolution. Early indications are that China's shale geology is different. And above ground, China lacks the extensive pipeline network that has enabled the United States to so quickly bring its new natural gas bounty to market. A daunting issue is whether water-intensive energy development can flourish in China given the strains the nation already faces on water and irrigation-dependent agriculture. Even though there are more questions at this point than answers, China is determined to move ahead.

"China now realizes it has incredible opportunity to find another major fuel source other than coal," says Albert Lin, chief executive of [EmberClear](#), an Alberta, Canada-based energy project developer that is a partner of China's largest power producer, China Huaneng Group.

Large Reserves, Uncertain Promise

Shale gas now makes up 25 percent of the U.S. natural gas supply, less than a decade after [Devon Energy](#) and other independent U.S. companies paired high-volume hydraulic fracturing with horizontal drilling to force natural gas from fissures in the soft black rock layer a mile or more underground. Development started near Dallas-Fort Worth, but it has since spread across the country, from Wyoming to Pennsylvania. The process has stirred intense debate over local land, water, and air pollution issues, including the accidental leakage of the potent greenhouse gas methane.

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But the flood of new natural gas onto the U.S. energy market has been a key factor in displacing coal. Coal's share of U.S. electricity production has dropped from almost 50 percent to 34 percent in just three years. Largely as a result of that trend, the United States is on track for its energy-

related carbon dioxide emissions in 2012 to be 11 percent lower than in 2005, the [U.S. Energy Information Administration](#) (EIA) projects.

In China, where coal now generates 80 percent of electricity, there is great potential to curb greenhouse gas emissions by substituting natural gas. A preliminary EIA assessment of world shale reserves last year indicated that China has the world's largest "technically recoverable" resources—with an estimated 1,275 trillion cubic feet (36 trillion cubic meters). That's 20 percent of world resources, and far more than the 862 trillion cubic feet (24 trillion cubic meters) in estimated U.S. shale gas stores.

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But not all shale deposits are alike. The best targets are marine deposits, formed by millions of years of heat and pressure from dead organic material that mixed with mud at the bottom of ancient seas. The decay produces methane, the main component of natural gas. Experts say Sichuan Province and the Tarim Basin in Xinjiang Province in the northwest hold promising marine deposits. Five other areas identified by the EIA as potential shale plays in China, including Inner Mongolia's Ordos Basin and parts of northern China, are more likely to hold non-marine deposits, lacking the rich stores of organic material. Still, from initial drilling in the more promising regions, "we know there's [at least] 6 to 8 trillion cubic meters of recoverable shale gas and maybe more" in China, says Friedmann.

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Other attributes of China's shale might pose additional challenges. It's believed that many of the deposits are mixed with clay. Clay's pliable, bendable quality makes it more difficult to fracture or break than shale containing more brittle quartz. In addition, shale in Sichuan is 1.2 to 3.7 miles (2 to 6 kilometers) below ground. On the higher end, that's deeper than many of the U.S. deposits, and the mountainous terrain above ground increases the difficulty and cost of drilling.

One of the top producing U.S. shale plays, Haynesville in east Texas and western Louisiana, has relatively deep deposits—1.9 to 2.5 miles (3 to 4 kilometers) below ground, notes Bruce Hill, senior geologist at the [Clean Air Task Force](#), a Boston nonprofit that works to lessen fracking's environmental impact. The U.S. experience would suggest that deep fracking can be done, but China's geology has yet to be fully explored.

"There is no cookbook for doing shale gas," says Edward Chow, senior fellow at the [Center for Strategic and International Studies](#) in Washington, D.C. China needs to do "a lot of experimentation and go through trial and error, examining different shales."

Seeking Best Location

As home to Asia's longest river, the Yangtze, and a network of existing natural gas pipelines, Sichuan is seen by outside experts as a logical place for China to launch its shale gas industry, especially compared to remote Tarim Basin, which lacks any of the vital infrastructure for producing or transporting gas. Still, the water demand of fracking—requiring millions of gallons—presents a serious concern, says David Fridley, a staff scientist at the U.S. Department of Energy's [Lawrence Berkeley](#) lab in California. China's per capita water availability is only a quarter of the world average, according to the [World Bank](#). And Sichuan, which produces 10 percent of China's grain, uses a great deal of its water resources for agriculture.

Other issues might also hamper development. The same geologic forces that formed Sichuan's steep mountains present sizeable seismic risk. It was in this region that a devastating earthquake killed 70,000 people in 2008; its epicenter was 215 miles (350 kilometers) northwest of Chongqing. Fracking has been linked with small earthquakes in England, and underground disposal of fracking wastewater has been traced to tremors in Ohio and Texas in the United States.

(Related: "[Tracing Links Between Fracking and Earthquakes](#)" and "[Report Links Energy Activities To Higher Quake Risk](#)")

Obtaining know-how also could be a stumbling block. "If they want to develop shale gas in five years, [China] has to partner with companies that really understand drilling and completion practices," says Friedmann.

State-owned [China National Offshore Oil Corporation](#) (CNOOC) entered into a joint venture with U.S. shale gas leader [Chesapeake Energy](#) two years ago, in a move experts viewed as a bid to gain access to expertise. In January, Sinopec, China's number two oil company, purchased a one-third stake in industry pioneer Devon Energy for \$900 million and commitment to cover \$1.6 billion of future drilling costs.

But it's unclear how much access to shale gas technology China will gain through those deals. Bo

Kong, assistant research professor at the [Johns Hopkins University School of Advanced International Relations](#) in Washington, D.C., notes that the Chinese firms hold minority stakes in the companies, with U.S. partners restricting technology transfer. The head of Sinopec, Fu Chengyu, is seen as taking a more politically cautious approach to collaboration with U.S. energy firms after opposition from Washington in 2005 killed his bid, when he headed up CNOOC, to take over the former Unocal Oil Company. (Similar controversy over foreign control of strategic U.S. assets has erupted over [CNOOC's \\$15.1 billion bid last month](#) to buy Calgary, Canada-based Nexen, which has substantial oil and gas drilling operations in the U.S. Gulf of Mexico.)

The smaller independent North American gas companies likely welcome Chinese investment, because their own finances have been pummeled by the low natural gas prices their own operations have wrought. But it will be deals with the big international oil companies on China's own turf that likely will bring shale gas expertise to the world's largest energy consumer, experts say. In March, [Shell](#)* signed the [first shale gas production-sharing agreement](#) ever in China, with state-owned China National Petroleum Corporation (CNPC), also known as PetroChina. ExxonMobil, BP, Chevron, and the French company Total also have embarked on shale gas partnerships in China.

In its 12th Five-Year Plan (2011-2015), China set the goal of producing 229.5 billion cubic feet (6.5 billion cubic meters) of shale gas by 2015; the United States produced about 30 times more shale gas in 2011. But while the U.S. shale gas revolution amounted to roughly a seven-fold increase in production in the past five years, China's aim is to ramp up shale production at least ten-fold between 2015 and 2020.

It remains to be seen whether China can surmount that steep trajectory, while facing even more daunting environmental challenges than those for shale gas development in the United States.

China is probing that question, as well as the shale, as it drills beneath the hills that surround Chongqing.

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